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Can space mining benefit all of humanity?: The resource fund and citizen's dividend model of Alaska, the 'last frontier'

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ABSTRACT

Economically profitable resource exploitation in space is becoming increasingly feasible as more actors - national, public and private-are engaging in space exploration. The Outer Space Treaty (OST), which serves as the basis for the current *corpus juris spatialis,* declares that no government can claim sovereignty over celestial bodies or outer space itself. Because this is generally interpreted as denying private ownership, the OST is sometimes claimed to be an obstacle to commercial venture, particularly resource exploitation. Such claims ignore a wealth of terrestrial models which promote profitable commercial resource exploitation independent of fee-simple ownership. To achieve an approach to space exploration and exploitation which balances national, international, and commercial interests and a need to prevent conflict and militarization of outer space, terrestrial approaches to managing resource exploitation should be carefully examined for frameworks and mechanisms with potential to serve as models in further elaborating an international regime for space resource exploitation. A previously overlooked terrestrial example, the Alaska Permanent Fund, and its unique citizen's dividend, is explored as one possible model for such a balanced approach that could encourage profit-driven exploration and exploitation of extra-terrestrial resources, reduce the risk of conflict between actors in outer space and simultaneously accrue tangible benefits to all of humanity.

1. The 'final frontier', utopian ideals and pragmatic governance: is it possible to balance commercial space exploitation, profit motives, and benefits to all of humanity?

In 1903, Konstantin Tsiolkovsky suggested that exploiting asteroid resources [1] would be key to conquering what Gene Roddenberry and his fellow producers later called the 'final frontier' [2]. While the idea of asteroid mining thus predates the space age, the prospect of a space economy fuelled in part by the exploitation of asteroids, the moon and other celestial bodies is increasingly technologically and financially feasible.

In situ resource exploitation is often cited as a crucial part of ambitious plans underway by the steadily increasing number of space-faring nations and commercial, entrepreneurial ventures in space-plans that include orbital outposts and hotels, space based solar power stations [3] and manned and/or robotic missions to the Moon and Mars in the coming decades. Resources from the Moon, Mars and asteroids have been proposed for use in human space exploration to produce propellants, water for life support, structural materials, radiation shielding and heat shields [1,4]. While competing and evolving visions for space exploration and political, budgetary and economic realities make the future of such plans uncertain, there are many indications that resource exploitation of near Earth objects (NEOs), the moon or other celestial bodies is rapidly becoming feasible [5].

Additionally, the mining of celestial bodies, including NEOs, has frequently been presented, both in specialist literature and in popular media as a way to solve terrestrial shortages of precious metals, semi-conducting materials and rare elements such as Helium-3. Because of its proximity and composition, the moon is an attractive starting point for resource prospecting [6]. On the other hand, NEOs have received particular attention because they may be richer in some desired raw materials, especially metals, than the surface of the moon, while also having a much weaker gravity well [7–10]. Public scientists and science communicators such as Neil deGrasse Tyson have promoted asteroid mining both as a way to solve conflicts over terrestrial resources while enriching humanity as well as providing the technologies necessary to detect and deflect asteroids that threaten Earth [11]. The popular founding manifesto for asteroid mining, John S. Lewis' *Mining the Sky* (1997) estimated that mining asteroids for valuable metals could provide trillions of dollars of precious metals [12], though such claims, oft

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repeated, should be regarded sceptically in absence of detailed and sophisticated economic modelling.

Some studies have optimistically suggested that profit making 'space mining' ventures could be undertaken with little or no government funding [8]. This does not, however, reflect that which has already been invested in research, surveys and mapping of celestial bodies and the development of space technology by governments (including public/private partnerships), or the necessary technological developments likely to emerge from future missions by NASA and other Space Agencies. NASA's use of Space Act Agreements to engage in public-private partnerships such as that with SpaceX and Orbital ATK is part of a broad reshaping of the aerospace industry that will see increased privatization and commercial activities in space and new forms of Public-Private Partnerships (PPPs) which may also play a role in space resource exploitation [13]. As greater numbers of actors, with complex relationships to stakeholders, including national governments, become active in outer space, the need to insure peaceful interactions, one of the primary goals of the OST, will be increasingly important.

Advocates of space exploration argue that human exploration (and utilization) of space has and will benefit all of humanity. Indeed, the rhetoric of space exploration has been, since at least the time of Konstantin Tsiolkovsky, imbued with both techno-utopian and religious overtones by many of its advocates, many of whom speak in prophetic terms of a space faring human destiny [14–17]. The influence of the 'Spaceship Earth' metaphor [18], Apollo era Earth-rise photographs and what Frank White has called the "overview effect" [19] have been cited by numerous environmentalists as having an influence on the developing environmental movement of the 1970's as well as offering humanity a vision of the Earth absent the political divisions seen on maps.[1]

Others take a more pragmatic approach, arguing that while space programs have already benefitted much of humanity, access to these benefits remains uneven and challenges remain for the future in this regard [20]. Advocates of the privatization and commercialization of space also often frame their advocacy in terms of the benefits to mankind and humanity as a whole [21], and there have been attempts to outline frameworks for the exploitation of resources in space which both provide for private entrepreneurship and profit making while also benefiting mankind as a whole [22]. Peter Diamandis, co-founder of the asteroid prospecting and mining company Space Resources, has recently cited Tsiolkovsky's famous words "Earth is the cradle of humanity but one cannot live in the cradle forever [23]," in advocating a moral duty to explore and colonize space and expounding on the many riches of outer space which will drive this project, end terrestrial conflicts over resources, and enrich humanity [24].

Unsurprisingly, there is a 'Silicon Valley' venture capitalist marketing spin in the discourse surrounding the prospect of commercial resource exploitation in space, characterized by appeals to the mythos of the Wild West, gold rushes and with not infrequent echoes of Manifest Destiny. While companies and entrepreneurs justifiably intend to enrich their investors, claims that this will in turn enrich humanity more generally sound suspiciously like trickle-down economics [25]. Private enterprise and the profit motive certainly have an increasingly crucial place in space exploration, and the current authors support commercial endeavors in space, but space is not the Wild West frontier of Frederick Jackson Turner [26], with 'free' land for the taking-it is an international commons regulated by the Outer Space Treaty as 'the common province of all mankind [27].' Thus, we argue that in a very real and legal sense, the sky belongs to everyone. Indeed, the current authors follow Virgiliu Pop [28] and others [29] in the view that outer space is a *res publica internationalis,* or *res communis,* as is the atmosphere, much of the oceans and the sea floor.

Is it possible to create a 'balanced' framework for the exploitation of outer space which encourages private enterprise while also tangibly accruing benefits to all humanity by a means more certain than vague platitudes and promises? Certainly, the need to create a stable framework for space exploration and resource exploitation has been highlighted by many authors [30]. However, underlying the many different approaches to space exploration and exploitation at the international, national and subnational levels are various and often divergent political, economic, philosophical and ideological visions of property, the commons, and the appropriation of natural resources [31,32] with important implications for humanity's future in space and how the benefits of such a future will accrue and be apportioned.

In considerations of future regimes governing outer space, it is common to look to analogous terrestrial examples of 'global commons' management such as the UN Convention on the Law of the Seas (UNCLOS) and the Antarctica Treaty System (ATS) for inspiration [22]. While acknowledging the importance of these treaty systems as potential models, the current authors suggest that to establish a balanced, pragmatic framework for the exploitation of outer space, other terrestrial resource regimes can provide useful models and mechanisms that can enrich these discussions.

In what follows, the present authors will briefly examine current debates with regard to the exploitation of outer space and the current *corpus juris spatialis* embodied in the Outer Space Treaty. It is our view that to achieve a balanced regime for the exploitation of outer space, building on the existing treaty system, policy makers, space agencies and would-be space mining entrepreneurs must be willing both to carefully examine existing terrestrial regimes of resource exploitation of public lands and global commons. The authors then examine one potential, and largely overlooked, terrestrial model of resource exploitation from Alaska, frequently referred to as the 'last frontier'.

The Alaska Permanent Fund, a type of Natural Resource Fund, is thus explored as a successful terrestrial example that encourages profit driven resource exploration and exploitation by commercial entities while also accruing tangible and sustainable benefits directly to residents of Alaska. Adapted to the 'final frontier' of outer space, the Alaska Permanent Fund and its citizen's dividend provide one possible model for building a balanced economic and legal framework with a purpose to encourage commercial enterprises, whether private or public, while simultaneously accruing tangible, quantifiable benefits to all of humanity, in keeping with the visionary ideals fitting for a human future in space.

2. The Outer Space Treaty, property rights and the exploitation of outer space

The Outer Space Treaty (OST) came into force in 1967 and, having been ratified by all the major space faring governments as well as some 100 other nations, the Outer Space Treaty serves as the basis for international space law, the current *corpus juris spatialis*. The treaty declares the exploration and use of outer space shall be for, "the benefit and in the interests of all countries [27]" and that outer space, as mentioned previously, "shall be the province of all mankind [27]".

With the increased commercialization of space, and the entrance of new actors, both national and private, the OST has come under increased scrutiny, with calls to expand, modify, and even to abrogate it [35,36]. Issues surrounding the mining of celestial bodies have received particular attention and debate [37]. Of particular concern is the matter of exploitation licences and property rights [38]. The OST expressly forbids the "national appropriation by claims of sovereignty, by means of use or occupation, or by other means" [27] of outer space and celestial bodies. This is frequently interpreted to mean that the OST denies private property claims in outer space, some authors and individuals [39–41] have argued that appropriation by non-national

[1] "When you're finally up at the moon looking back on earth, all those differences and nationalistic traits are pretty well going to blend, and you're going to get a concept that maybe this really is one world and why the hell can't we learn to live together like decent people."— *Frank Borman, Apollo 8,* Newsweek Magazine, *23 December 1968*.